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THREE SPECIES OF ODOSTOMIA FROM NORTH CAROLINA, WITH DESCRIPTION OF NEW SPECIES

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Introduction. Fretter and Graham (1949) pointed out the ectoparasitic nature of the Pyramidellidae, a family of small gastropods that feed on certain marine invertebrates. They described the feeding apparatus and mode of life of these gastropods: "Each species feeds on a particular species of host, usually a tubiculous polychaete or a lamellibranch mollusc, obtaining attachment to the body by means of the oral sucker, piercing the body wall with the buccal stylet and sucking blood and perhaps tissue debris, by means of the buccal pump." They listed the host species of 6 pyramidellids. More recent work has focused attention on species that parasitize economically important bivalves. Cole and Hancock (1955) reported on two species that damage the European oyster, *Ostrea edulis*. On the east coast of the United States, *Odostomia (Menestho) bisuturalis* feeds on the young of the American oyster, *Crassostrea virginica* (Loosanoff 1956); and *Odostomia (Menestho) impressa* feeds on adult oysters (Hopkins 1956, Wells 1959). Another species, *Odostomia (Chrysallida) seminuda,* previously reported from scallops *(Aequipecten irradians),* has been observed feeding on the slipper shell *Crepidula fornicata* (Robertson 1957).

Allen (1958) questioned the host specificity attributed to the Pyramidellidae by Fretter and Graham. On the other hand, Berry (1954) indicated that their close host-parasite specificity provides the best explanation for the existence of many closely related

species in this family. Certainly, this is a large family, with many species separated by small, microscopic differences. The abundance of species and the seemingly minor shell differences, which have been utilized to separate them, have discouraged research on these snails. Often, it has been difficult to recognize features of shell sculpture that are taxonomically significant and separate them from intraspecific variation. Consequently, some variations from a single form have been described and named as separate species; yet small differences between species have sometimes escaped recognition.

In the course of an analysis of the fauna of oyster beds, we found that a number of small pyramidellid gastropods occurred in this habitat in the vicinity of the Duke University Marine Laboratory at Beaufort, North Carolina. *Odostomia (Menestho) impressa,* the most abundant pyramidellid in this habitat, has been treated elsewhere (Wells 1959). Three other species, belonging in the subgenus *Chrysallida,* are the subject of this report. Because these 3 species superficially resemble one another, they are easily confused. Evidently, the members of this species complex have not been distinguished previously; instead, they have been treated as a single species, *Odostomia (Chrysallida) seminuda.* The purpose of this report is to clarify the taxonomy of these forms, to distinguish between them, and to provide information on their distribution and feeding habits.

Taxonomy. Upon initial examination, this pyramidellid complex appeared to include two undescribed species, in addition to *Odostomia (Chrysallida) seminuda* C. B. Adams, 1839. However, subsequent examination showed that one species had been described previously, not from the western Atlantic, but as being from Japan. This species will be treated first; then a description of the new species will follow.

ODOSTOMIA (CHRYSALLIDA) DUX Dall & Bartsch, 1906 (Fig. 4)

Dall and Bartsch (1906) described a number of new species from a collection of Pyramidellidae supplied by the Berlin Museum. This material included collections of H. and A. Adams, Paetel, Dunker, and Hilgendorf, and contained many species from Japan. From this material, Dall and Bartsch described, figured, and named a minute specimen as *Odostomia (Chrysallida) dux* (p. 350; Pl. 17, fig. 4). After its description, they noted, "It is from

Japan and belongs to the Paetel collection."

Contained in collections of Pyramidellidae in the United States National Museum and in the authors' possession are a number of specimens from North Carolina that fit perfectly the description of *O. dux*. These specimens superficially resemble *Odostomia seminuda* C. B. Adams, which also occurs on the Atlantic Coast of the United States; those in the U.S.N.M. collection had been grouped under that species.

The type specimen of *Odostomia (C.) dux* had 4 post-nuclear whorls and measured 1.8 x 1.0 mm. Corresponding North Carolina specimens with 4 post-nuclear whorls possess identical measurements. Included in these North Carolina collections are several larger specimens, with up to 5½ post-nuclear whorls, measuring up to 3.1 x 1.5 mm.

Presumably, the type specimen of *O. dux* was returned to the Berlin Museum. In view of other locality errors in the Berlin Museum material, it is quite likely that the type locality cited for *O. dux* by Dall and Bartsch was erroneous. In the same article, these authors noted specimens of 5 other species contained in the Berlin collection which apparently were also cited incorrectly as being from Japan. Three previously described species from the west coast of Mexico and one from the West Indies had been cited in the Paetel collection as having come from Japan; two species from Alaska had been incorrectly cited in the Clessin collection as having come from Japan. All the specimens recorded below were collected in North Carolina, with a single possible exception labelled "Coast of N. & S. Carolina."

Material examined (The number of post-nuclear whorls in each specimen is included in parentheses): 2 specimens (4½, 5) from Shackleford Jetty, Beaufort Inlet, N.C.; subtidal; 1955. 1 specimen (2½), 1 dead shell (4½) dredged off Ocracoke, N.C.; 1959. 9 specimens (3, 4, 4, 4, 4, 4, 4½, 5, 5½) on shells, Beaufort, N.C.; subtidal; 1955-1956. 1 specimen (5½) labelled "Coast of N. & S. Carolina" by C. B. Adams; 1871; U.S.N.M. 24702. 1 specimen (5½) from off Cape Hatteras, N.C., U.S.F.C. Sta. 2284-86; 13 fathoms; 1885; U.S.N.M. 43967, labelled as *Odostomia cancellata* (D'Orb.). 1 specimen (4½) from 25 miles SE from Cape Fear, N.C., D2619; 15 fathoms; 1885; U.S.N.M. 97508a. 2 specimens (4½, 4½) from 17 miles SE by E ½E of Cape Lookout, N.C., U.S.F.C., D2608; 22 fathoms; 1888; U.S.N.M. 94585b. 2 dead shells (5, 5½) from off Beaufort, N.C., Eolis Sta. 21; 6-9 fathoms; 1910; U.S.N.M. Henderson Coll. (no number). 3 dead

shells (4½, 5, 5) from Beaufort, N.C. area; U.S.N.M. Henderson Coll. B1446.

ODOSTOMIA (CHRYSALLIDA) DIANTHOPHILA, new species (Fig. 1)

Description: Shell small, elongate-ovate, white. Nuclear whorls moderately large, deeply immersed in the first post-nuclear whorl, from which only the peripheral portion of the last oblique volution projects. Post-nuclear whorls somewhat flattened, strongly crenulately shouldered, marked between the sutures by 17 axial ribs and 5 spiral cords, the posterior two of which are a little more closely spaced than the rest. Each junction of an axial rib and a spiral cord is marked by a tubercle; the tubercles of the first and second cord are somewhat fused. The fourth spiral cord is wider and well separated from the third cord. Base moderately well rounded, attenuated, ornamented with 4 or 5 more or less distinct flattened spiral threads, reticulated by slender continuations of the axial ribs. Sculpture of the base and of the body of the last whorl near the aperture often obsolete. Aperture pear-shaped, posterior angle acute, somewhat channeled; outer lip thin, somewhat advanced in the middle in larger specimens; columella strong, curved, provided with a strong fold; parietal wall covered by a thin callus.

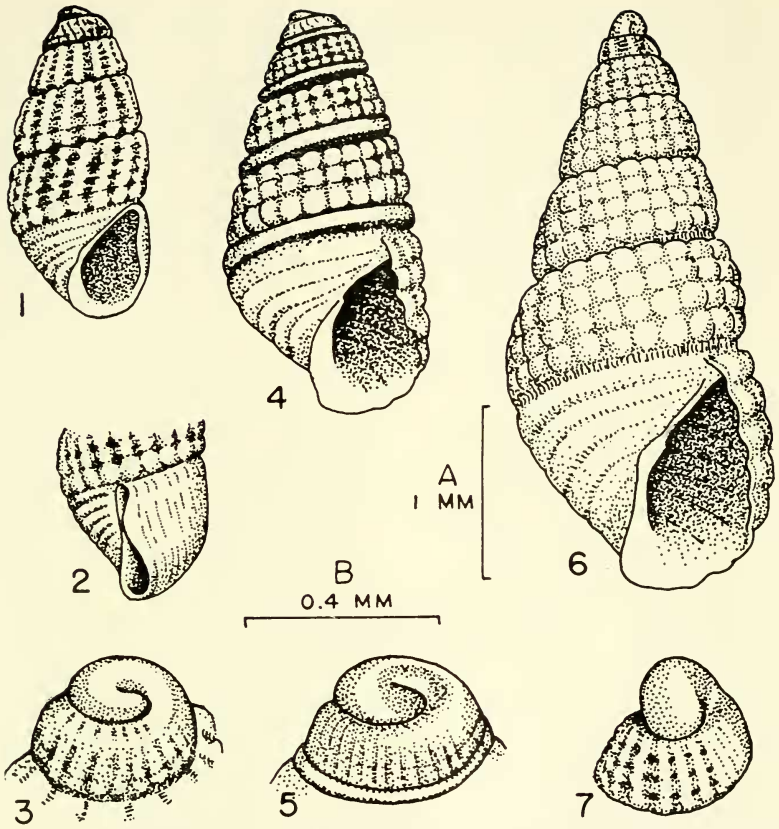
The holotype has 4½ post-nuclear whorls and measures 1.8 mm. in length, and 0.8 mm. in width. This is the maximum size observed for this species.

This species is named *dianthophila* in allusion to its affinity for the serpulid polychaete *Eupomatus dianthus* Verrill.

Type locality: Beaufort, North Carolina (1955). The holotype (U.S.N.M. 613499) and a series of paratypes (613500) from the same collection have been deposited in the United States National Museum.

Material examined: 210 specimens collected near the Duke University Marine Laboratory, Beaufort, N.C., 1955-1956; 10 specimens dredged off Portsmouth Island, N.C., 6 fathoms, June 1959; 1 specimen dredged in Pamlico Sound, N.C., 2 fathoms, October 1960.

Comparisons of Shell Characters. Microscopic examination reveals several clear-cut differences between these three species. Whereas *O. seminuda* bears 4 rows of tubercles on each whorl (Fig. 6), *O. dux* bears 3 rows of tubercles and a smooth spiral keel, situated just above the suture (Fig. 4); and *O. dianthophila* bears 5 rows of tubercles (Fig. 1). While the axial ribs of *O. seminuda* and *O. dux* disappear above the suture, those of *O. dianthophila* may extend well below the suture onto the base. The shell of adult *O. seminuda* is larger than those of the other two species, achieving 4.0 mm. in length in contrast to maxima of 3.1 mm. in *O. dux* and 1.8 mm. in *O. dianthophila*. In addi-



Figs. 1-3, *Odostomia (C.) dianthophila:* 1, adult shell. 2, lower part of shell showing obsolete sculpture and shape of outer lip. 3, apical whorls. Figs. 4-5, *O. (C.) dux:* 4, adult shell. 5, apical whorls. Figs. 6-7, *O. (C.) seminuda.* 6, adult shell. 7, apical whorls. (Figs. 1, 2, 4, 6, to scale A; Figs. 3, 5, 7 to scale B. Drawn with the aid of camera lucida.)

tion, the shell of *O. dianthophila* is consistently more slender in proportion to its length than are those of the other two species. The nuclear whorls of *O. seminuda* form a small projecting spire, the axis of which is almost at right angles to that of succeeding whorls (Fig. 7). In contrast, the nuclear whorls of *O. dux* and *O. dianthophila* are deeply immersed in the first post-nuclear whorl, with only the peripheral portion of the last oblique volution appearing above the edge (Figs. 3 and 5).

Ecology. Feeding habits: As Robertson (1957) noted, *Odostomia seminuda* has been recorded from the valves of the bay

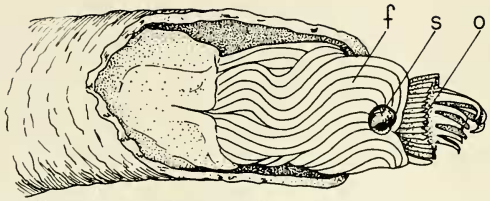


Fig. 8, *Odostomia (C.) dianthophila* (s) among branchial filaments of serpulid annelid, *Eupomatus dianthus* (preserved); parts of calcareous worm tube removed. (Drawn with the aid of camera lucida; f = branchial filaments, o = operculum of annelid.)

scallop, *Aequipecten irradians*. Robertson reported this species feeding on *Crepidula fornicata*, a sessile gastropod which utilizes a ciliary feeding method similar to that employed by bivalve mollusks. In this study, *Odostomia seminuda* has been found on the valves of the scallop *Aequipecten gibbus* dredged from off Ocracoke, North Carolina. Several specimens were found near the ventral margin of the scallops' valves, but most were located on the "ears" of the shell.

While there is insufficient evidence to justify any conclusions on the feeding relationships of *Odostomia dux*, this species has been collected in the vicinity of tubicolous polychaetes upon which it may feed. The shell of this species dredged off Ocracoke had been incorporated into a sand tube of the tubicolous polychaete, *Sabellaria vulgaris* Verrill, attached to the shell of the scallop, *Aequipecten gibbus*. The smaller, live specimen from that collection was found in a nearby crevice between other fouling organisms. Fretter and Graham (1949) have indicated that a related species, *Odostomia (Chrysallida) spiralis*, feeds on *Sabellaria* species in British waters.

Odostomia dianthophila feeds upon the serpulid annelid *Eupomatus dianthus* Verrill. The host polychaete produces white calcareous tubes that are cemented to shells, rocks, pilings, and other hard substrates; the species is distributed from New England to the West Indies and the Gulf of Mexico (Hartman 1951), and is an important fouling pest to the oyster industry in some areas. This polychaete bears a terminal plume of ciliated pinnate branchial filaments that open for feeding. When disturbed, it quickly retracts into its calcareous tube, completely withdrawing the branchial filaments which are then protected by

a stalked, trumpet-shaped operculum. A number of specimens of *O. dianthophila* have been recovered from inside the tubes of both living and preserved *Eupomatus dianthus.* They apparently were carried inside the tube when the polychaete host retracted. Most specimens were located among the branchial filaments behind the operculum (Fig. 8); however, two were lodged in the thoracic region of one worm (preserved). As many as three specimens of *O. dianthophila* have been found in the tube with a single worm. There can be little doubt that they were feeding on this polychaete.

Fretter and Graham (1949) have reported two species *(Odostomia unidentata, O. lukisii)* feeding on a British serpulid, *Pomatoceros triqueter,* and described this process in detail.

Generally specimens of *O. dianthophila* were found only in the larger tubes of *E. dianthus.* The *E. dianthus* typically retracts whenever there is a disturbance in its vicinity, or if it is exposed by low tides. The minute size of *Odostomia dianthophila* permits its being carried inside the calcareous tube of the polychaete when the host retracts. By this behavior pattern, the serpulid worm inadvertently affords the pyramidellid protection from would-be predators or adverse conditions.

The occurrence of this species in the tube of *Eupomatus dianthus* has a counterpart in the occurrence of two British species of *Odostomia* within the valves of pelecypods. *Odostomia scalaris* penetrates between the valves of the blue mussel, *Mytilus edulis,* and *O. eulimoides* penetrates between the valves of the European oyster, *Ostrea edulis.* In both species, the host responds by producing a thin-walled pocked that excludes the pyramidellid from the host's tissues. No such mechanism for isolating *O. dianthophila* has been observed in *E. dianthus.*

Salinity: On the basis of their occurrence in the Beaufort area, *Odostomia dux* appears to be more restricted to relatively high salinities than is *O. seminuda. Odostomia dianthophila* is much more capable of penetrating into estuarine areas than either of the other two species, having been collected among oyster shells at Cross Rock in Newport River (in the Beaufort area), and in Pamlico Sound. It has been collected repeatedly in salinities of 24 and 25 o/oo, and once in a salinity of 15 o/oo after a four week period of similarly low salinity values. However, in higher

salinities, all three species have been represented in single collections.

Reproduction: Typical pyramidellid egg masses (like those figured by Thorson 1946 and Wells 1959) belonging to *Odostomia seminuda* were observed on scallop shells collected in January, 1959. Robertson (1957) has indicated that this species spawned in July (1956) at Woods Hole, Massachusetts. As is the case with many other marine invertebrates, reproduction in *O. seminuda* appears to be directly related to water temperatures. In this case, the spawning of *O. seminuda* coincided with a temperature of about 65°F. Such water temperatures are recorded for Woods Hole in mid-July, 1956 (Bumpus, 1957). Apparently, a similar temperature occurred off Ocracoke Island, N.C., in January 1959, as one can interpolate from the hydrographic data collected at nearby lightships (Day, 1960).

There is no information available on the reproductive period of *O. dux*. Juvenile specimens of *O. dianthophila* were relatively abundant in the Beaufort area in June and July of 1955 and 1956, and several extremely small specimens (with scarcely more than the nuclear whorls) were recovered from material dredged off Portsmouth Island, N.C., in June, 1959. In view of the occurrence of its juvenile stages, *O. dianthophila* appears to spawn in late May, June, and July, exhibiting a breeding pattern in the Beaufort area similar to that of *Odostomia impressa* (Wells, 1959).

On the basis of their larval shells, there is evidently a long planktonic larval stage in *O. seminuda,* while in *O. dux* and *O. dianthophila* the planktonic stage is suppressed. However, the coincident recovery of all three species from single collections and the absence of intermediate forms indicate that the differences in the larval shells are not variations induced by different salinities.

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collections were made during the course of a broad study of oyster associates at the Duke Marine Laboratory.

SUMMARY

The taxonomy of 3 species of pyramidellid gastropods from North Carolina is treated. *Odostomia (Chrysallida) dux* Dall & Bartsch is reported from North Carolina and the suggestion made that the locality citation made for the type specimen (Japan) is incorrect. *Odostomia (Chrysallida) dianthophila* is described as a new species and distinguished from *O. seminuda* C. B. Adams and *O. dux.*

Odostomia seminuda is newly recorded from the scallop, *Aequipecten gibbus; O dianthophila* is reported as an ectoparasite of the serpulid polychaete *Eupomatus dianthus. Odostomia dianthophila* has been found inside the tubes of the retracted worm, behind the operculum among the branchial filaments. This species is successful in penetrating into estuarine areas of reduced salinity. Other aspects of their biology are discussed.

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HYDROBIID SNAILS FROM LAKE PONTCHARTRAIN, LOUISIANA

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During ecological studies on Lake Pontchartrain in 1953 and 1954, Rezneat M. Darnell and his associates took a series of